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# RESEARCH NEWSLETTER

A Publication from the Maine Department of Transportation's Research Division

MAINEDOT
Maine Department of Transportation

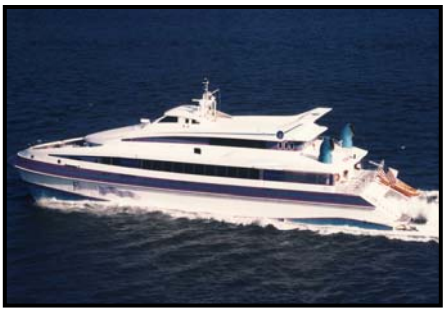
## Fast Ferry Makes Waves

The Department's Explore Maine initiative is creating an innovative new passenger transportation system that will allow travelers to access Maine without their automobiles. This initiative includes further development of the "marine highway" by improving port facilities and providing a more effective ferry system. A two phased research study was recently completed that addresses the feasibility of a high speed ferry fleet in Maine.

All fast ferry types depend upon the reduction of surface tension and resistance by either reducing hull drag or by creating dynamic lift. There are four main types of fast ferries, each achieve lift and/or reduce drag in distinct ways: monohulls, catamarans, hydrofoils, and hovercrafts.

Fast ferries hull forms have been developing for years resulting in the parallel development of materials. Aluminum and composite materials have undergone advances in recent years, and have led to stronger and lighter vessels.

Propulsion technology using gas turbines and diesel engines, which are lighter and capable of producing more horsepower, are constantly being developed. When properly sized and coupled to the propellers, or propulsors, they can easily produce vessel speeds in excess of 50 knots.



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The quality of the ride is of utmost concern with fast ferries. Pitching, heaving, and rolling can all lead to levels of motions sickness which are not acceptable. The use of computer controlled trim tabs and/or t-foils help eliminate most of these motions and reduce sickness.

The development in the design and the operation of high-speed vessels has created a need for revamping the regulations governing their design and safety. The result of all of the factors will be vessels which can offer passengers superior comfort and ride quality with maximum safety.

When new fast ferry routes are being planned, a key issue to be addressed is the effect of the wake-wash produced by these high speed vessels. Effective management of wake-wash requires an understanding of how it creates a risk for shoreline property structures and the environment. Site evaluations can establish threshold limits for each, and then vessels operators should be required to demonstrate that the proposed vessel and operational techniques can meet those limits.

Results of this research study will be used in the upcoming years as the "marine highway" infrastructure develops and more privately owned fast ferry services emerge.

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DEPARTMENT OF TRANSPORTATION ★ UNITED STATES OF AMERICA ★


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# Safe Ways to School

MaineDOT recently released the results of a comprehensive, research project to determine existing rates of bicycling and walking to school in Maine. The "Maine – Safe Ways to School" project was initiated with the expectation that the results will be useful in developing policies and practices, both state and local, to promote bicycling and walking to schools. Trends toward increased obesity and physical inactivity are inversely related to declining rates of biking and walking. The study revealed that just five percent of the overall student population walks or bikes to school during fair weather. From a transportation and public health policy perspective, MaineDOT and other agencies have a common interest in identifying the infrastructure, policy, and programmatic causes of these conditions, as well as a common goal of helping to reverse the trends. Four school districts with a combined population of 5,500 students were selected for the study. A baseline survey of methods of travel to school, and attitudes about biking and walking, was followed by analysis conducted by the University of Maine Center for Research and Evaluation. The final report includes a full summary of the project process, findings, recommendations, and implementation measures, including infrastructure improvements, promotional events and policy, and practice changes at the local and state-agency and administrative level. The report is available online at http://www.maine.gov/mdot/opt/bike/ or by calling the MaineDOT Office of Passenger Transportation at 207-624-3252.

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## New Projects

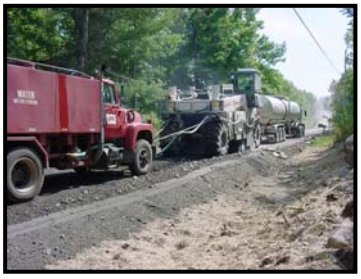
In 2003, the following research studies were selected and approved for funding by the MaineDOT Research Advisory Council.

- Integral Abutment on Shallow Ledge – Phase 2
- Safe Ways to School– Phase 2
- Evaluation of Context Sensitive Solutions Along Mid-coast RT. 1 Corridor
- Determination of Structural Strength of Plant Mix Recycled Asphalt Pavement Materials
- Fate of road salt in uncontaminated bedrock aquifers
- Performance related specifications for hot mix asphalt pavements
- Effects of roads on movements and mortality of blandings and spotted turtles in southern Maine
- Maine Advanced Technology in Transit Systems (MATTS)
- Evaluation of abutment scour at Maine Bridges
- Evaluation of traffic calming effects on vehicular speed

### Look For Our Next Issue:

- Self-Consolidating Concrete
- Rosphalt 50 for Bridge Surfaces
- New Approved Products
- Stone Matrix Asphalt
- Traffic Signal Safety
- Integral Abutment on Shallow Ledge

# MaineDOT Adds Foamed Asphalt to Highway



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MaineDOT has been rehabilitating roads using the full depth reclamation process for the past ten to fifteen years.

Full depth reclamation is the process of milling bituminous asphalt down to the gravel base and reusing the milled material, known as recycled asphalt pavement or RAP, as a base for Hot Mix Asphalt. Using this process eliminates reflective cracking and conserves natural resources. RAP has similar characteristics as gravel with greater stability and is very workable.

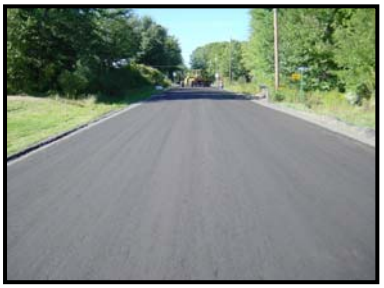
In addition to using full depth reclaimed material, MaineDOT has been experimenting with adding a number of stabilizing agents to recycled base materials to increase stability. Some of the stabilizing agents include cement, emulsion, calcium chloride and foamed asphalt.

Foamed asphalt is a mixture of air, water and hot asphalt. Cold water is introduced to hot asphalt causing the asphalt to foam and expand by more than 10 times its original volume. During this foaming action the asphalt has a reduced viscosity making it much easier to mix with aggregates.

In 2001, a 6.3 mile project on Route 8 in the town of Belgrade was selected for full depth reclamation, foamed asphalt treatment. A specialized piece of equipment milled the existing bituminous pavement and base material and introduced foamed asphalt all in one process. The material was then graded and compacted. Traffic was immediately allowed on the stabilized base. A hot mix asphalt base and wearing surface was applied to complete the process.

The project will be evaluated by the Transportation Research Division over a five-year period to monitor the performance of foamed asphalt treated base material.

Post construction test results of the Belgrade project were so encouraging that MaineDOT has dramatically increased the number of foamed asphalt projects in 2003-2004.



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Projects completed in 2002 were subjected to a detailed investigation to determine the structural capacity of the foamed asphalt layer. Testing and analysis completed by Worcester Polytechnic Institute resulted in values reported in the table below. For more information contact Tim Soucie at Timothy.Soucie@maine.gov or by phone at 207-624-3264.

| Project | Age in Years | Laboratory Resilient Modulus (ksi) | Backcalculated Modulus (ksi) | Layer Coefficient |
|---|---|---|---|---|
| **Belgrade-Rt 8** | >2 | 180.4 | 144.9 | .22 |
| **Orient Cary-Rt 1** | <1 | 306.2 | 95.0 | .23 |
| **Farmington-Rt156** | <1 | 355.9 | 265.0 | .22 |
| **Macwahoc-Rt 2A** | <1 | 482.4 | 363.3 | .35 |

# Research Assists M&O

The Transportation Research Division recently completed two research projects related to winter maintenance. One involved the evaluation of a new type of snow plow cutting edge. Another project evaluated the ice-melting effectiveness of liquid calcium.

**Field Testing of Snow Plow Cutting Edges**

MaineDOT uses almost 2,500 carbide cutting edges on its fleet of highway snow plow trucks during an average winter. This represents almost 9,000 linear ft. of cutting edges and an annual expenditure of roughly $150,000. Longer lasting cutting edges could lead to significant cost savings, not only from the reductions in the number of blades used, but also from the labor cost savings from reduced blade replacement. The purpose of the this project was to field test a new type of carbide cutting edge to determine if longer wear times could be achieved.

The cutting edges, or "plow blades", are used to resist abrasion caused by pavement. Tungsten carbide, a complex metal alloy, is used to strengthen the wearing edge of the blades. These tungsten carbide blades cost $300-400 per truck. The number of replacement blades used in any particular season depends on the number and severity of winter storms and the condition of the roads. Blades usually have to be replaced on each plow truck at least once per winter season. One manufacturer has developed an innovative edge blade with isolated carbide dowels inserted in the blade. This configuration was designed to reduce breakage and wear, and promote longer blade life.

The field tests consisted of outfitting several trucks with new test blades of the new design. An equal number of similar trucks where outfitted with conventional stock carbide blades. Trucks and crews for the test were chosen with similar length plow routes, with similar road classification and pavement conditions. The number of hours of plowing time, miles traveled, temperature, and snow condition were recorded by the drivers during each plowing run. The tests continued until the blades wore out. Test locations were established in different geographical areas of the State, and included both asphalt and concrete pavement. Despite the increased cost, the test blades did not last as long as the regular blades. It is not clear why this occurred. The reduced surface area of carbide in contact with the pavement may contribute to faster abrasion. It is not known if the new type blades resist breakage better than the standard blade as this was not evaluated during this project. While the test blades did not perform well, they did wear better on concrete pavement than on asphalt pavement, though the standard carbide blades lasted the longest even on the concrete pavement. This project demonstrated that the new type blade is not a cost-effective application for Maine roads. In addition, the project has a established baseline of performance data for future comparisons and evaluations of plow blades.

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**Ice-Melting Effectiveness of Liquid Calcium**

MaineDOT, like other state transportation agencies in the northern U.S., utilizes rock salt to melt snow and ice on roads and bridges during winter. MaineDOT is also currently implementing FHWA recommendations for anti-icing and de-icing procedures using liquid chemicals. Mixing liquid chemicals with solid rock salt has a beneficial effect. This procedure, called pre-wetting, reduces scattering as the material exits the truck spreader. This serves to keep the solid salt on the pavement instead of on the roadside where it is wasted. Several liquids can be used for pre-wetting rock salt. The most popular liquids in the snow-belt states are salt brine and liquid calcium. Liquid calcium, however is significantly more expensive than salt brine ($1.00 per gallon vs. $0.08 per gallon). This project measured and compared, in a laboratory setting, the ice-melting effectiveness of rock salt, both with and without added liquid calcium, and salt brine. The goal was to compare liquid calcium with salt brine at concentrations of 8 gallons per ton of solid salt, to determine if there is enough of a performance advantage to justify the additional cost.

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The results showed that liquid calcium rapidly encourages melting at a concentration of 8 gallons per ton at certain temperatures. At colder temperatures, however, liquid calcium did not help significantly, precisely when it would be expected to perform better than salt brine. These findings were surprising and will need to be replicated. In addition, a field test should conducted to confirm the results.


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